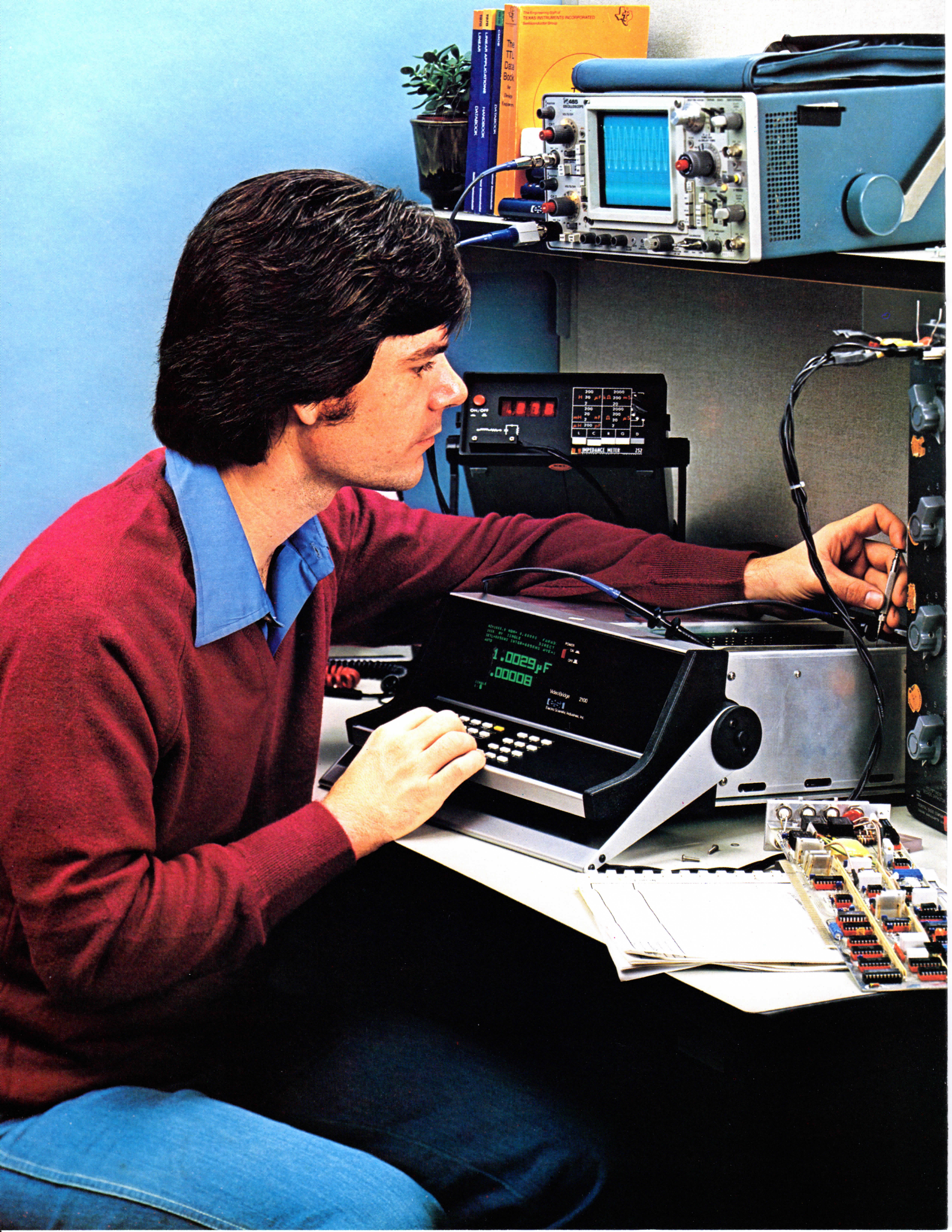
Impedance Instruments Catalog

A full performance spectrum


The TTL Data Book
IMPEDANCE METER
252
1.0029pF
.00008
VideoBridge
2100

ESI. The long-time leader in impedance measurement.

Impedance measurement. It's a subject that demands an unflagging dedication to detail and accuracy. A discipline where a few parts per million can define the difference between success or failure.

Starting in 1953, Electro Scientific Industries became involved in the business of impedance measurement. From that time on, we've developed and manufactured resistance reference standards so accurate they are used as primary standards, traceable to the National Bureau of Standards.

As time passed, we added other precision calibration equipment to a growing product line. Our reputation for top-level resistance standards and calibration instruments spread to labs around the world. Our people became recognized as authorities on the subject.

Soon we expanded our expertise to cover more aspects of impedance measurement. At the same time, we incorporated the best of new technology into our instrument designs. The result has been a constant increase in cost-effectiveness and ease of use. With the same firm commitment to accuracy that we've always had.

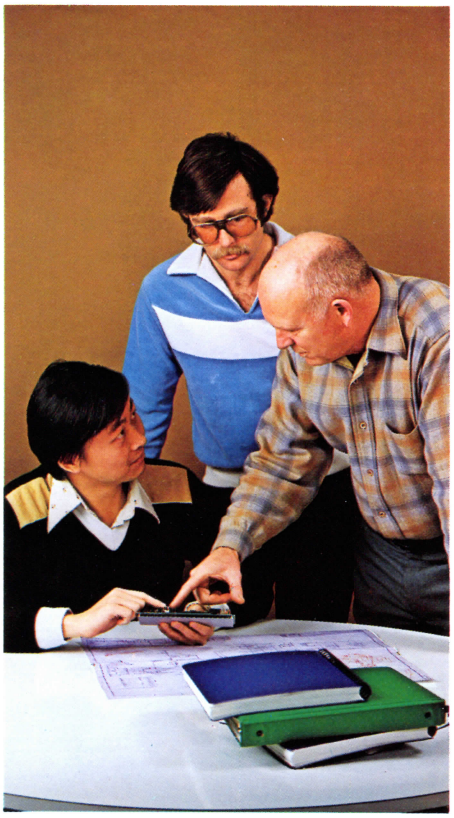
Our impedance measurement instruments have also benefited from our extensive involvement in other high-technology fields. For example, ESI is the world's major supplier of computer controlled laser trimming systems.

Today, ESI retains the same mixture of technological aggressiveness and conservative specification. On the technological side, we've designed instrumentation to allow precision measurements even in unfriendly environments. We've dramatically increased measurement throughput with the introduction of microprocessor control. And vastly expanded instrument intelligence through user-definable software. These advancements have made us the leading supplier of impedance testing equipment to passive component manufacturers.

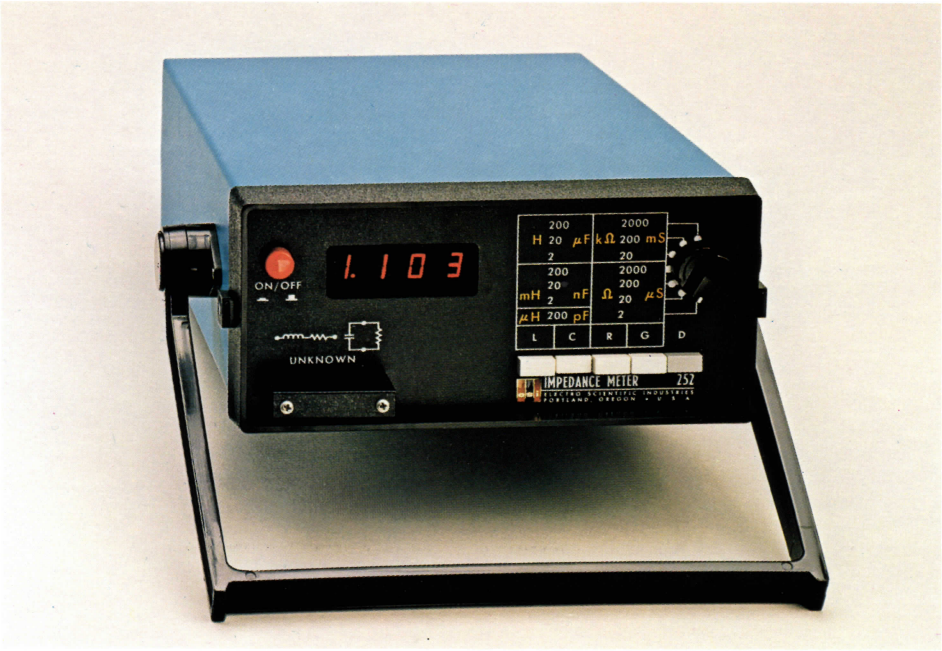
On the specification side, we still maintain the most rigorous and conservative of standards. Typically, our instruments perform beyond their specified accuracy during normal use.

How do we maintain such outstanding quality? Through scrupulous attention to components, materials and the manufacturing process. Only the finest parts are used, the proprietary designs are frequently employed. For instance, we've made our own highly stable precision wire wound resistors. We utilize extensive testing in our quality assurance program, including burn-in.

When it comes to impedance measurement, ESI has good reason to be proud. For many years, our instrumentation has led the industry in both performance and innovation. The contents of this catalog will quickly show you why.



Whatever your Impedance test application, ESI has a cost-effective answer.



Low cost, high performance.

Now you can have true impedance measurement in a price range that is easily affordable. The 252 Series of Digital Impedance Meters give you L,R,C, and D and G as well. All at a performance level usually confined to much more expensive instruments.

The 252 is the basic 1kHz model, with autoranging available on the 253 and low frequency (120/100Hz) operation provided by the 254. On all three models, you'll find a wealth of performance features. Items such as external bias, analog outputs, and input protection. Basic accuracy is an impressive 0.25% with higher repeatability possible during short-term precision work.

Since the 252 weighs only 7 lbs. (a battery-powered model is also available, for total portability), you can rapidly get it where it's needed most. And when it gets there, ESI's exclusive Kelvin Klips® assure a solid 4-terminal contact to the unknown. Also, when connected to a comparator the 252 can become the heart of a go/no go test system.

Behind it all is a rugged design concept that's proven itself thousands of times over. From the chassis down to individual circuit components, there's been no compromise in quality.

The 252, 253 and 254 Digital Impedance Meters are aimed specifically at keeping your instrument costs down and your measurement accuracy up.

Microprocessor-based automation.

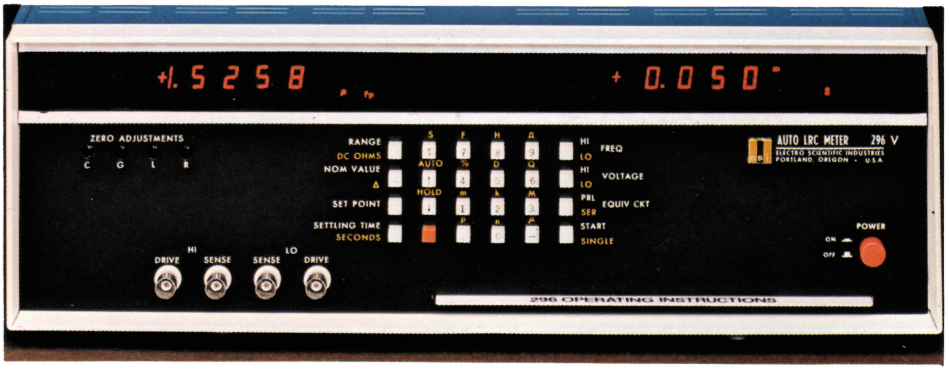
High-speed production systems demand impedance test instruments with ever higher throughput and accuracy. ESI's 296 series of Auto LRC Meters exceeds today's stringent high-speed and high accuracy testing and sorting requirements.

The 296 uses a microprocessor as its controlling element. The result? Greatly accelerated test times. Advanced accuracy. Selectable test frequencies and voltages. Plus a wide array of data manipulation and display possibilities. All determined by the user's programming input.

The 296 easily fits into a larger automated production picture. Interface options, such as IEEE-488, RS-232 or card reader put programming control where it's most effective. And a parts handler interface option gives a high-speed link to automated testing and sorting equipment.

The 296 covers the full impedance measurement spectrum: L,R,C,G, and also calculates D and Q. All with a basic accuracy of 0.1%. Even at measurement speeds as fast as 80ms. Incorporating fully guarded, six-terminal connections.

The basic 296 model includes two software-selectable voltages and frequencies: 1VRMS/0.1VRMS and 1kHz/120/100Hz. The 296V expands this to 8 voltages. The 410 uses 1MHz and three voltage levels to test components specified at high frequencies. Special versions provide frequencies to 20kHz for testing components used in switching power supplies.



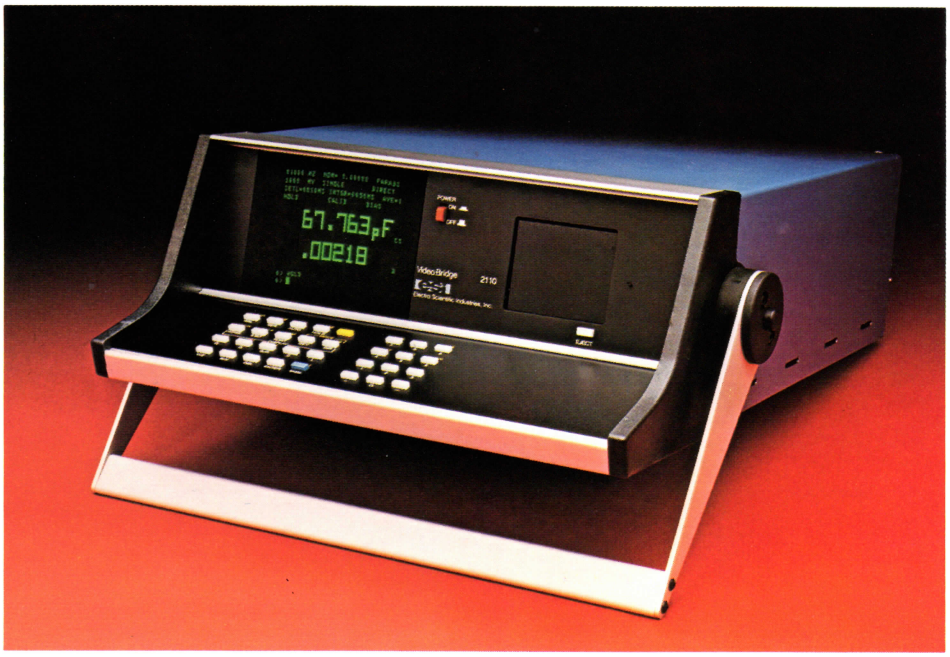
Total Graphic Capability

The 2100/2110 VideoBridge™ takes microprocessor-based impedance measurement to its logical end. A single instrument now manages the entire test, sort and analysis process. From measurement setup to comprehensive data display and formatting.

To start, you have 12 basic measurement functions inherent in the 2100/2110's software and hardware: Ls, Lp, Rs, Gp, Cs, Cp, D, Q, X, B, Z, and Y. Selectable frequencies from 20Hz to 20kHz. And a wide range of voltages and currents. Through keyboard commands, you can create an optimum set of test parameters that duplicate actual circuit conditions of the component or match the component's testing specifications.

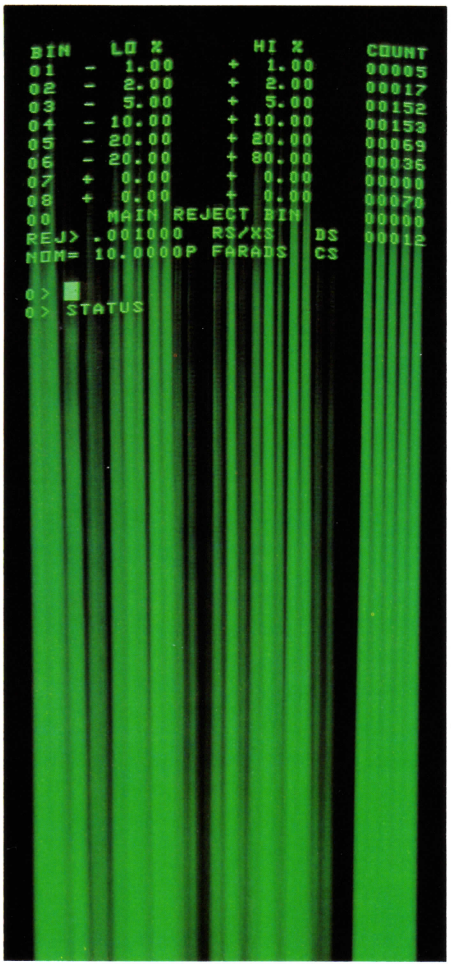
The results obtained reflect basic accuracy levels of .05%. Acquired data is then stored in memory for convenient display on the 2100/2110's CRT. Once again, software selection gives exactly what you need. Along with all test parameters, the display can include the contents of up to 11 sorting bins.

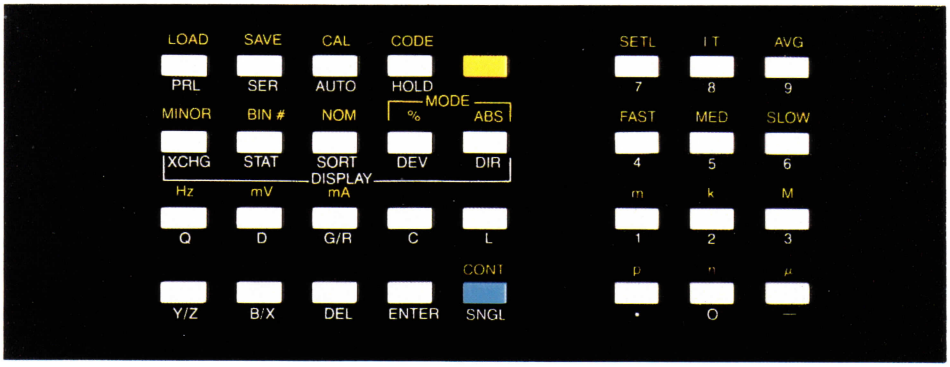
The 2110 version of the VideoBridge goes one step further. Through cassette mass storage, you can preprogram test routines, saving considerable labor time and eliminating error. Also, acquired data can be analyzed and documented in a variety of forms.



A number of powerful options let you interface the 2100/2110 with larger automated systems. RS-232 or IEEE-488 interfaces allow remote programming and control. A parts handler interface permits automated testing and sorting operations.

In every respect, the 2100/2110 is the most significant achievement yet in the field of impedance test instrumentation.





A full performance spectrum.

	252	253	254
Measurement Parameters	L, R, C, G, D		
Basic Accuracy	0.25%		
Capacitance Ranges	0.1pF resolution to 200μF	0.1pF resolution to 2000μF	1.0pF resolution to 20,000μF
Test Levels	1VRMS, 0.1VRMS (range dependant)	1VRMS, 0.1VRMS, 0.01VRMS (range dependant)	
Test Frequencies	1kHz		120Hz
Test Connection	4-terminal connection to unknown		
Speed	≈4.0 measurements per second		
Display	3½-digit display		
IEEE-488			
RS-232			
Handler Interface			
Special Features	Autoranging—253 Battery-powered special model—252, 253 +50V External Bias Go/No-Go Limit Comparator Option Analog Output		

296	296V	410	2100	2110
L_s, L_p, R_s, G_p, C_s, C_p, D, and Q		L_s, L_p, R_s, G_p, C_s, C_p, D, Q, X and B	L_s, L_p, R_s, G_p, C_s, C_p, D, Q, X, B, Z, Y.	
0.1%			0.05%	
120Hz: 0.1pF resolution to 2F 1kHz: 0.01pF resolution to 0.2F	120Hz: 0.1pF resolution to 20mF 1kHz: 0.01pF resolution to 2mF	0.0001pF resolution to 20nF	0.001pF resolution to 2.0F	
1VRMS or 100mVRMS (selectable)	8 selectable test voltages to 1VRMS	1V, 100mV or 10mV RMS (selectable)	To 1.5VRMS or 100mA, set by keyboard entry	
1kHz and 120Hz		1MHz	Selectable from 20Hz to 20kHz	
6-terminal active guard		4-terminal	5-terminal	
≈9 per second	≈13 per second	≈7 per second	Selectable from 5 per second	
Two 4½-digit displays			CRT display, 3 to 6 digits	
✓	✓	✓	✓	✓
✓	✓	✓	✓	✓
✓	✓	✓	✓	✓
Charged capacitor input protection Programmable Limits		Autoranging or Range Hold modes Fixture Auto-zeroing		
+200V Bias		±200V Bias	50V Bias	
High-speed and special test frequency (20kHz) units available				Data Cassette

2100/2110 VideoBridge. A complete impedance picture at your fingertips.

ESI's VideoBridge is truly a timely innovation. On one hand, modern production requirements mean steadily rising speed and accuracy during test and sorting. That's why our 296 line of production testers was created. On the other, passive component technology is demanding ever finer impedance test requirements that will stay on a continuously rising curve. To meet those demands, we designed the VideoBridges.

The 2100/2110 VideoBridge gives you a long-term solution to your testing needs. It's possible through a state-of-the-art synthesis of digital and impedance measurement technology. For the first time, a microcomputer-based CRT, keyboard and software have been integrated with the finest in impedance measurement hardware. The result? A new standard in impedance test instrumentation. One that will serve your needs for many years to come.

The 2100/2110 displays impedance functions (L, R, C, G) in either series or parallel. It also calculates D, Q, X, B, Y, and Z. What's exceptional is the range of measurement parameters its software lets you select: 3,000 discrete test frequencies from 20Hz to 20kHz. Test voltages to 1.5VRMS in 10mV steps. Current to 100mA in 1mA steps. All with a basic measurement accuracy of .05%. In effect, you can now test components under conditions that duplicate those of the actual circuitry they're targeted for.

Automatic test and sort? The 2100/2110 has an optional parts handler interface dedicated to the task. The instrument's standard software lets you sort using up to 11 bins. In either absolute or percent values, with a parts count up to 64,000 for each bin.

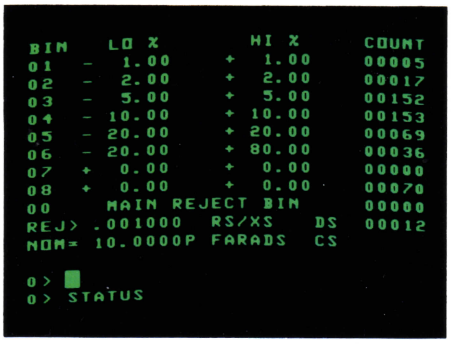
Through its CRT, the 2100/2110 puts all test information where it's available at a glance. Primary information, such as a measurement

value or a sorting band, is displayed in large characters for quick readability. Other test information is neatly formatted for quick visual access.

Programming is simple. A brief series of keystrokes enters initial test parameters. As you make alterations, your last two keyboard entries are always displayed at the bottom of the CRT. Programming errors are immediately indicated by an ERROR message at the bottom of the screen.

The 2110 VideoBridge gives you the added benefit of a cassette system for vastly expanded data storage, analysis and management. Individual test programs can be retained for repeated use. Histograms can be generated. Stress-related component drift can be documented. ESI currently offers several applications-dedicated software packages in cassette form, with more available soon.

VideoBridge hardware options include a parts handler for automated test and sort. An RS-232 interface for access to other digital devices. An IEEE-488 interface for connecting to GPIB systems. And non-volatile memory for retention of test parameters after power-down. A wide variety of test fixtures complete the connection to the unknown.



2100, 2110 Specifications

Test Conditions:
Level —1000mV/100mA
Speed —Medium
Range —Auto
Bias —Off
Calibrated—Zero

Bias: +50VDC maximum

Basic D Accuracy:
Capacitance: ±0.00025 (1+D²)*
Inductance: ± 0.00035 (1+D²)*

Basic Q Accuracy:
All components:
$\pm 0.035 \left(Q + \frac{1}{Q}\right)\%$*

Power Requirements:
115VAC +15% –22% 48/66Hz
230VAC + 9% –22% 48/66Hz

Test Signals:
Frequency: ≈2998 programmable between 20Hz and 20kHz.
f = 60kHz/N
Where: N is an integer 3≦N≦3000
Accuracy: ±0.01%

Level Set:
Voltage Level: 10mV to 1500mv maximum
Accuracy: ±(4% + 10mV), Z > 2Ω
±(4% + 2mV), Z < 2Ω

Measurement Speed:

	SETL	I.T.	AVG
Fast	5ms	10ms	1
Medium	50ms	50ms	1
Slow	50ms	50ms	5

Current Level: 1mA TO 100mA maximum
Accuracy: ±(4% + 1mA), Z < 32Ω
±(4% + 0.2mA), Z > 32Ω

Dimensions and Weight: H 13.3cm (5.25 in); **W** 32.4cm (12.75 in); **D** 46.4cm (18.25 in); **Wt.** 14.5kg (32 lb) net.

***Correction Factors**

For HI Z (Z≧10MΩ) add to basic D or Q accuracy $\left[0.0005 \left(\frac{Z(M\Omega)}{10M\Omega}\right)\right]$

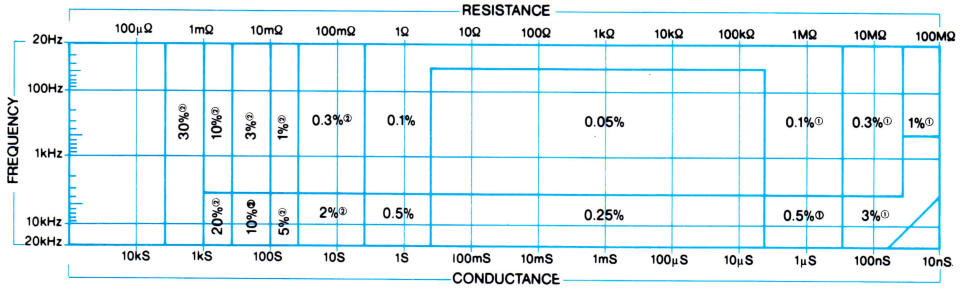
For LO Z (Z≦1Ω) add to basic D or Q accuracy $\left[0.0005 \left(\frac{1\Omega}{Z(\Omega)}\right)\right]$

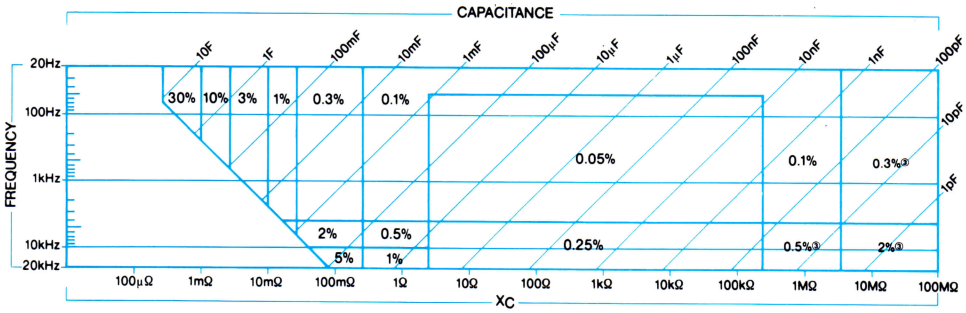
For Frequencies > 1000Hz multiply basic D or Q accuracy by $\left(1 + \frac{Hz}{3000}\right)$

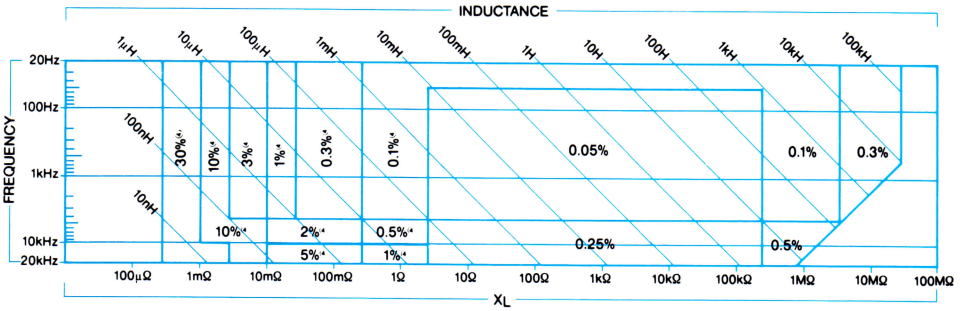
For Frequencies < 200Hz multiply basic D or Q accuracy by $\left(1 + \frac{60}{Hz}\right)$

For V_{test} < 800mV multiply basic D or Q accuracy by $\left(1 + \frac{300}{mV}\right)$

For I_{test} ≦ 100mA multiply basic D or Q accuracy by $\left(1 + \frac{300}{mA \times Z(\Omega)}\right)$







①+[0.1nS×f(kHz)+0.5nS]
②+[0.01mΩ×f(kHz)+0.1mΩ]
If Q>1, add [0.1%(1+0.3Q²)] to accuracies shown

③ $+ \left(\frac{0.01pF}{f(kHz)} + 0.01pF\right)$

If D>1, add [0.05% (1+0.3D²)] to accuracies shown

④ $+ \left(\frac{0.01\mu H}{f(kHz)} + 0.01\mu H\right)$

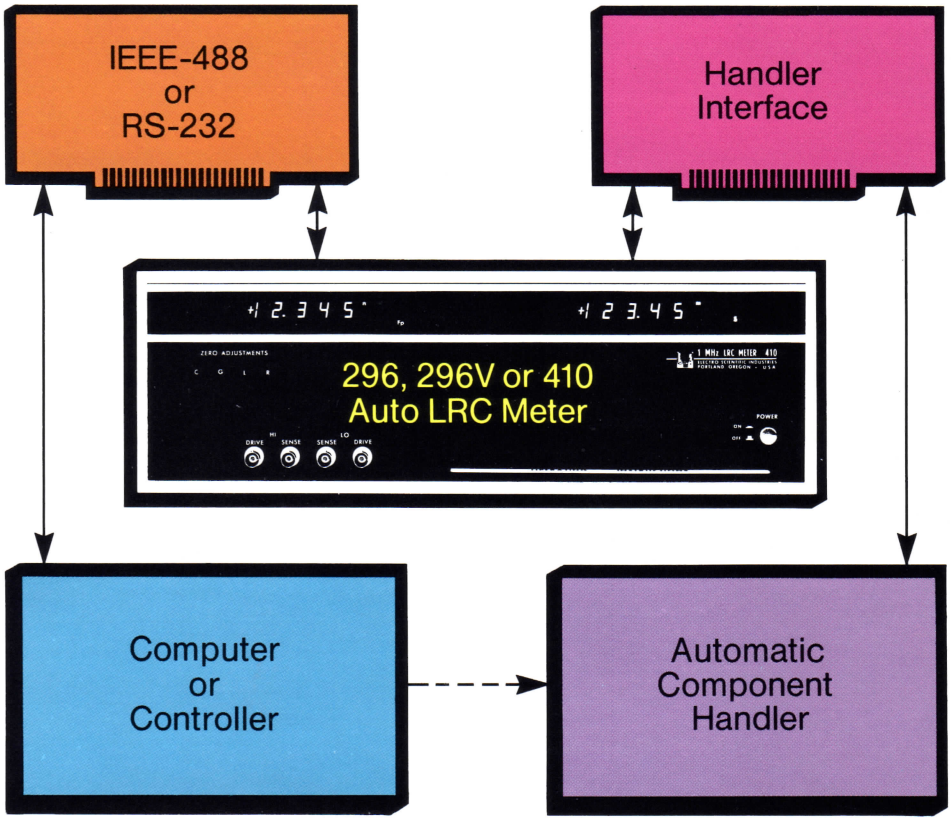
If D>1, add [0.1% (1+0.3D²)] to accuracies shown

296, 296V, 410
Microprocessor-based control for automated testing and sorting.

To bring impedance testing up to modern production standards, you need a special combination of automation, flexibility, speed and accuracy. Precisely the kind of requirements met best through microprocessor control. With this thought in mind, ESI offers the 296, 296V and 410 Automatic Digital LRC Meters.

All three models were designed to meet the needs of the high-volume component supplier. The 296 puts 2 frequencies (1kHz and 120/100Hz) and 2 voltages (0.1VRMS and 1.0VRMS) under software control to measure L, R, C, G, D, and Q. The 296V adds six more test voltages plus other features. The 410 uses a 1MHz test signal for components specified at a higher frequency. No matter which model best meets your needs, you get the same μP-based performance power. User programming is done simply and quickly through a front panel keyboard matrix, or remotely through GPIB, RS-232 or card-reader interfaces. You have all measurement functions, ranges, voltages and frequencies under fast, accurate software control. With a basic accuracy of 0.1% and measurement times as fast as 63ms.

You can program for either parallel or series component equivalent circuits. With selectable digital averaging plus the ability to shift capacitance and inductance ranges up an extra decade. The results come up on two 4½ digit displays, one for reactance values, the other for loss.



You can also program in multi-band tolerance sorting. For reactance or loss. In absolute or percent deviation. With up to 10 limits, giving 9 accept bands and one reject band for highs and lows. In addition, a single maximum limit can be programmed for a second loss reject parameter. Bridge settling time is also under program control, from 25ms to 1.0 second, in 10ms increments.

To put the 296/296V/410 to work in an automatic test and sort operation, several optional features are available. One is a parts handler interface with relay outputs for band indication and remote start. Others are a GPIB, RS-232 or card-reader interfaces for connection to remote programming or control sources.

296, 296V, 410 Specifications

296 Ranges

			0	1	2	3	4	5	6	7	8
ADMITTANCE	RANGE NUMBERS										
	RANGES	C_p,C_s 1kHz	19.999mF	1.9999mF	199.99μF	19.999μF	1.9999μF	199.99nF	19.999nF	1.9999nF	199.99pF
		C_p,C_s 120Hz [1]	199.99mF	19.999mF	1999.9μF	199.99μF	19.999μF	1999.9nF	199.99nF	19.999nF	1999.9pF
		G_p 1kHz and 120Hz [1]	100.00S	10.000S	1.0000S	100.00mS	10.000mS	1.0000mS	100.00μS	10.000μS	1.0000μS
		R_s 1kHz and 120Hz [1]	19.999mΩ	199.99mΩ	19.9999Ω	19.999Ω	199.99Ω	.9999kΩ	19.999kΩ	199.99kΩ	1.9999MΩ
	TEST SIGNAL	HI Voltage	0.001VRMS	0.01VRMS	0.1VRMS	1VRMS					
		LO Voltage				0.1VRMS					
	BASIC ACCURACY	HI Voltage	±0.5%		±0.1%						
IMPEDANCE	RANGES	L_s,L_p 1kHz		19.999μH	199.99μH	1.9999mH	19.999mH	199.99mH	1.9999H	19.999H	199.99H
		L_s,L_p 120Hz [1]		199.99μH	1999.9μH	19.999mH	199.99mH	1999.9mH	19.999H	199.99H	1999.9H
		R_s 1kHz and 120Hz [1]		100.00mΩ	1.0000Ω	10.000Ω	100.00Ω	1.0000kΩ	10.000kΩ	100.00kΩ	1.0000MΩ
		G_p 1kHz and 120Hz [1]		19.999S	1.9999S	199.99mS	19.999mS	1.9999mS	199.99μS	19.999μS	1.9999μS
	TEST SIGNAL	HI Current		100mA			10mA	1mA	100μA	10μA	1μA
		LO Current		10mA			1mA	100μA	10μA	1μA	0.1μA
	BASIC ACCURACY	HI Current		±0.1%							±0.5%
	D RANGE		1.9999 (Accuracy ±1% of reading + 5 X 10^{-4})								
	Q RANGE		1999.9								

296V Ranges

			0	1	2	3	4	5	6	7	8
ADMITTANCE	RANGE NUMBERS										
	RANGES	C_p,C_s 1kHz			199.99μF	19.999μF	1.9999μF	199.99nF	19.999nF	1.9999nF	199.99pF
		C_p,C_s 120Hz [1]			1999.9μF	199.99μF	19.999μF	1999.9μF	199.99nF	19.999nF	1999.9pF
		G_p 1kHz and 120Hz [1]			1.0000S	100.00mS	10.000mS	1.0000mS	100.00μS	10.000μS	1.0000μS
		R_s 1kHz and 120Hz [1]			1.9999Ω	19.999Ω	199.99Ω	1.9999kΩ	19.999kΩ	199.99kΩ	1.9999MΩ
	TEST SIGNAL	HI Voltage			0.1VRMS	1VRMS					
		LO Voltage			0.05VRMS	0.5VRMS					
IMPEDANCE	RANGES	L_s,L_p 1kHz			199.99μH	1.9999mH	19.999mH	199.99mH	1.9999H	19.999H	199.99H
		L_s,L_p 120Hz [1]			1999.9μH	19.999μH	199.99mH	1999.9mH	19.999H	199.99H	1999.9H
		R_s 1kHz and 120Hz [1]			1.0000Ω	10.000Ω	100.00Ω	1.0000kΩ	10.000kΩ	100.00kΩ	1.0000MΩ
		G_p 1kHz and 120Hz [1]			1.9999S	199.99mS	19.999mS	1.9999mS	199.99μS	19.999μS	1.9999μS
	TEST SIGNAL	HI Current			100mA		10mA	1mA	100μA	10μA	1μA
		LO Current			50mA		5mA	500μA	50μA	5μA	0.5μA
	D RANGE		1.999								
	Q RANGE		1999.9								

410 Ranges

			1	2	3	4	5
ADMITTANCE	RANGE NUMBERS						
	RANGES	C_p,C_s	19.999nF	1.9999nF	199.99pF	19.999pF	1.9999pF
		G_p,B	125.66mS	12.566mS	1.2566mS	125.66μS	12.566μS
		R_s	12.566Ω	125.66Ω	1.2566kΩ	12.566kΩ	125.66kΩ
		D,Q.	D to 0.1999, Q to 1999.9				
	TEST SIGNAL LEVEL	HI	1.0V rms				
		MED	100mV rms				
		LO	10mV rms				
	BASIC ACCURACY (HI & MED V)		±0.2%	±0.1%			±0.2%
IMPEDANCE	RANGES	L_s,L_p	1.9999μH	19.999μH	199.99μH	1.9999mH	19.999mH
		R_s,X	12.566Ω	125.66Ω	1.2566kΩ	12.566kΩ	125.66kΩ
		G_p	125.66mS	12.566mS	1.2566mS	125.66μS	12.566μS
	TEST SIGNAL LEVEL	HI	10mA rms	10mA rms	1mA rms	100μA rms	10μA rms
		MED	10mA rms	1mA rms	100μA rms	10μA rms	1μA rms
		LO	1mA rms	100μA rms	10μA rms	1μA rms	1μA rms
	BASIC ACCURACY (HI & MED V)		±0.4%	±0.2%			±0.3%
	D ACCURACY		±(1% of reading + 10 X 10^{-4})				

ZERO ADJUSTMENT	296	296V	410
R (hi-freq only)	±20mΩ	±20mΩ	±0.2Ω
L	±0.5μH	±0.5μH	±0.2μH
C	±20pF	±20pF	±4pF
G	±50nS	±50nS	±4μS
MEASUREMENT SPEED			
1kHz	As low as 80ms	As low as 80ms	
120Hz	As low as 133ms	As low as 133ms	
1MHz			As low as 135ms

Power Requirements: 120 VAC (100, 220, 240 VAC optional), 60Hz (50Hz optional). 100 W.

Dimensions and Weight: H 13.5cm (5.3 in) with feet 15cm (6 in); W 43cm (17 in); D 40.5cm (16 in); **Wt.** 14kg (30 lb) net.

[1] 100Hz for 50Hz line frequency.

252/253/254
A low-cost solution to high-level performance needs.

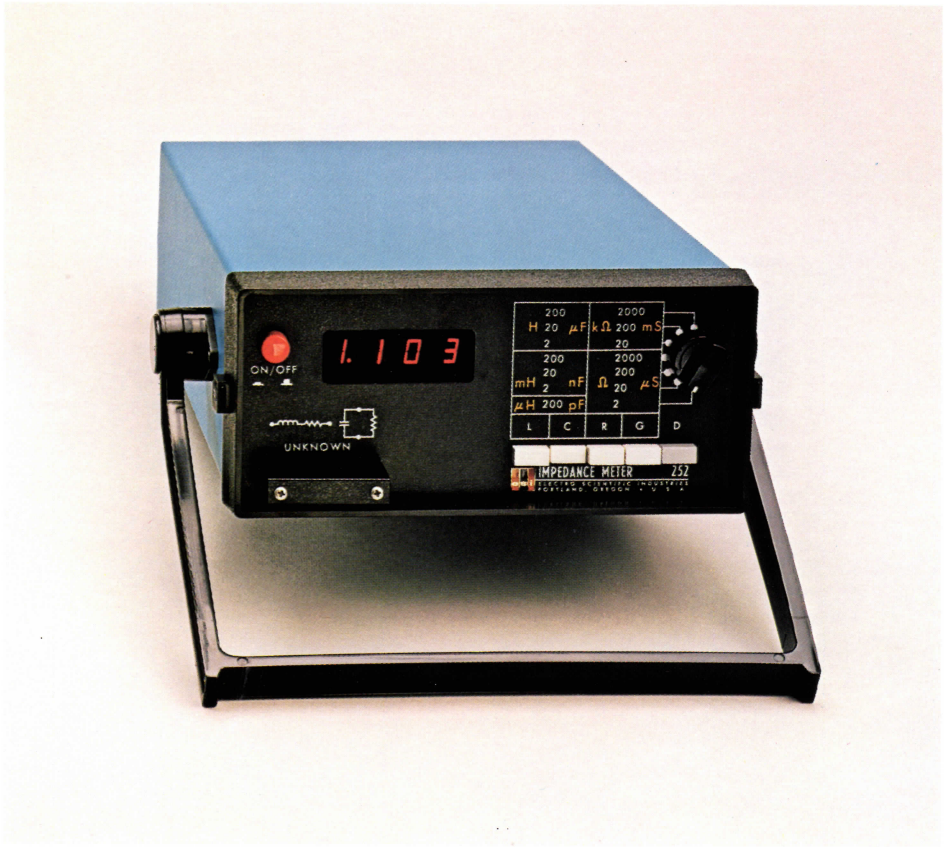
ESI's 252 LRC Meter is decisive proof that top level performance doesn't always mean a hefty price tag. The 252 and its companions, the autoranging 253 and low frequency 254, will easily stand up to instruments several times more costly.

The key is the 252's strategically chosen set of performance specs and operating features. Basic accuracy is 0.25%, with a capacitance range to 200μF. The 253 extends capacitance to 2000μF and the 254 gives an extension to 20,000μF.

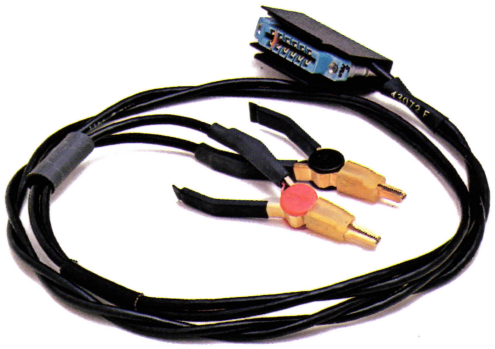
All three models give you 3½ digit values for L, R, C, G, and D. No "sliding balance" or other frustrations. Just touch a button and observe the readout. At a rate of 4 measurements per second. Test frequency for the 252 and 253 is 1kHz. The 254's frequency is 120Hz, making it ideal for testing electrolytic or tantalum capacitors.

The 252 has many built-in features to reinforce its high reliability and performance levels. Special circuitry largely cancels the effects of temperature, humidity and stray field problems. In short, the 252 gives you friendly measurements even in an unfriendly environment.

The 252/253/254 uses the same measurement technique as our higher-priced instruments. And there's a provision for external bias voltage (0 to 50Vdc) through terminals on the rear panel. A battery-powered model is available for true portability.



To extend the 252 into an automatic sorting operation, there's the 1412B Limits Comparator. It works with the 252's analog outputs to check a component within tolerance ranges set around a nominal value. You can sort C and D simultaneously, or substitute R, L, or G as appropriate. The front panel readout produces simple GO, LO or HI indications. Rear Panel outputs provide a parts handler interface.



252, 253, 254 Specifications

252 RANGES									
RANGE NO.		0	1	2	3	4	5	6	
	L_s	200µH	2mH	20mH	200mH	2H	20H	200H	
	C_p	200pF	2nF	20nF	200nF	2µF	20µF	200µF	
	R_s	2Ω	20Ω	200Ω	2kΩ	20kΩ	200kΩ	2000kΩ	
	G_p	2µS	20µS	200µS	2mS	20mS	200mS	2000mS	
	D	1.999							

253 RANGES									
RANGE NO.		0	1	2	3	4	5	6	7
	L_s	200µH	2mH	20mH	200mH	2H	20H	200H	200H
	C_p	200pF	2nF	20nF	200nF	2µF	20µF	200µF	2000µF
	R_s	2Ω	20Ω	200Ω	2kΩ	20kΩ	200kΩ	2000kΩ	2000kΩ
	G_p	2µS	20µS	200µS	2mS	20mS	200mS	2000mS	20S
	D	1.999							

254 RANGES									
RANGE NO.		0	1	2	3	4	5	6	7
	L_s	2000µH	20mH	200mH	2000mH	20H	200H	2000H	2000H
	C_p	2nF	20nF	200nF	2µF	20µF	200µF	2000µF	20mF
	R_s	2Ω	20Ω	200Ω	2kΩ	20kΩ	200kΩ	2000kΩ	2000kΩ
	G_p	2µS	20µS	200µS	2000µS	20mS	200mS	2000mS	20S
	D	1.999							
ACCURACY (15°C to 35°C)	L_s	±(0.25% + (1 + 0.002R_s*) digits)**	±(0.25% + (1 + 0.001R_s*) digits)					±(0.25% + (1 + 0.002R_s*) digits)	±(0.25% + (1 + 0.002R_s*) digits)
	C_p	±(0.25% + (1 + 0.002G_p*) digits)**	±(0.25% + (1 + 0.001G_p*) digits)					±(0.25% + (1 + 0.002G_p*) digits)	±(0.5% + (1 + 0.004G_p*) digits)
	R_s	±(0.25% + (1 + 0.002L_s*) digits)	±(0.25% + (1 + 0.001L_s*) digits)					±(0.25% + (1 + 0.002L_s*) digits)	±(0.25% + (1 + 0.002L_s*) digits)
	G_p	±(0.25% + (1 + 0.002C_p*) digits)	±(0.25% + (1 + 0.001C_p*) digits)					±(0.25% + (1 + 0.002C_p*) digits)	±(0.5% + (1 + 0.004C_p*) digits)
	D	±(1% + 0.002) for L or C ≧200 counts ±(2% + 0.010) for L or C50 to 199 counts							±(2% + 0.10)
TEST SIGNAL	Voltage C_p,G_p	1.0VRMS		0.1VRMS					0.01VRMS
	Current L_s,R_s	100mA	10mA	1mA	100µA	10µA		1µA	

Test Frequency: 1kHz (252 & 253); 120Hz (254)

Measurement Speed: 4 per second; one second required for first reading after connection to unknown.

Connection to Unknown: Four-terminal, guarded.

Display: 3½ digits with decimal point; blanked for overload conditions.

Bias: 0 to 50VDC.

Analog Outputs: L, C, R or G, with simultaneous output of D for L and C.

Static Charge Protection: Diode and resistor discharge network.

Power Requirements: 100 to 125V or 200 to 250V, 50/60Hz, 4W.

Options: 254 100Hz test frequency.

Dimensions and Weight: **H** 10cm (4 in); **W** 26cm (10 in); **D** 37cm (14.6 in); **Wt.** 3.2kg (7 lb) net.

*Digit count, same range.
**After correction for test lead zero reading. 0°C to 15°C and 35°C to 50°C: add 0.1 (rated accuracy)/°C.

How to Order

Terms and Conditions

Terms

Terms are net 30 days. Minimum billing is $50.00. This also applies to spare parts, but excludes instruction manuals. ESI reserves the right to change the price, design, specifications, or appearance of its products at any time without notice or incurring the obligation either to modify units previously manufactured or to furnish products with previously published specifications.

Delivery

Most standard items and their spare parts are off-the-shelf to 60-day delivery. When custom assemblies or special products requiring engineering are ordered, we will include in our quotation a statement on delivery. Improved delivery can be had by ordering standard catalog items. When ordering spare parts, please identify instrument model and serial number.

Shipment

Please specify method of shipment. If air freight is requested, specify airlines, otherwise air freight forwarders are used. If no instructions are given, ESI will determine bestway surface route. Unless otherwise requested, shipments will be insured for minimum value with carrier.

Damage or Breakage

If a shipment is received damaged or broken, file a report at once with the agent of the transportation company and make a claim to them. Then notify us here at the factory, and we will give you instructions for returning the equipment.

Order Cancellation Charge

Any order for catalog items which is cancelled by the customer will be subject to a cancellation charge equal to 15 percent of the purchase price. Any special product order which is cancelled by the customer will be subject to a minimum cancellation charge based on the time cancellation notice was received in writing at ESI and the amount defined as a percentage of the contracted sales price.

Calendar days prior to acknowledged shipping date	Percentage of contracted sales price
Over—151 days	10%
121—150 days	15%
91—120 days	20%
61— 90 days	25%
31— 60 days	30%
0— 30 days	35%
After Shipment	50%

In some cases, special engineering charges may be incurred for work done before receipt of the cancellation notice. These would be in addition to those listed above.

Initial Calibration

All ESI equipment is calibrated prior to shipment using ESI reference standards, and when applicable, a certificate of traceability of calibration accompanies each instrument. Calibration data is furnished (as noted in price list) with many ESI products classifed as standards.

Warranties

Warranted Accuracy

Initial Accuracy

The specifications stated in this catalog are intended as acceptance specifications and are guaranteed for 60 days from the date of shipment. They are typically maintained for a much longer period of time.

Long-Term Accuracy:

These specifications are guaranteed for the standard warranty period, and are typically maintained for the life of the instrument. Long-term accuracy is implied when not otherwise stated.

Calibration Accuracy:

Calibration accuracy is the accuracy of ESI calibration data relative to the legal units maintained by the U.S. National Bureau of Standards.

Standard Test Conditions:

All accuracy specifications are quoted for calibration laboratory conditions, at 23°C and at low power unless otherwise specified. Maximum power ratings apply to typical measurement applications in which power is applied for short periods of time with cooling periods between.

Warranty of Quality

Electro Scientific Industries, Inc., warrants its products to be free from defects in material and workmanship. Rigorous quality control permits the following standard new equipment warranties:

1. Two years for components and instruments utilizing passive circuitry.
2. One year on components and instruments utilizing active circuitry as identified in the price list.

During the in-warranty periods, we will service or, at our option, replace any device that fails in normal use to meet its published specifications. Batteries, tubes and relays that have given normal service are excepted. Special systems will have warranty periods as listed in their quotation.

Certificates Available

Warranty of Quality and Warranty of Traceability:

Whenever applicable, both standard printed forms are enclosed in the back section of Instrument Manuals at no charge.

Signed Warranty of Traceability:

Same form as in above statement with signature, date of test, model and serial numbers. There will be no charge for requests accompanying the order—$5.00 will be charged for requests received after shipment of the instrument.

Certificate of Calibration:

Includes model and serial numbers, date of test, signature and set of readings. (The fee for this service will be listed in the current Price Schedule for Calibration and Readings.) If you ask for this service after the unit has been shipped, you must return the unit to the factory for recalibration, transportation prepaid. Records on most instruments do not include all readings and may not satisfy your requirements. (Copies of rough checkout sheets are not available.)

Certificate of Conformance:

Certifies that the item or items being shipped conform to the published (or quoted) specifications. If this certificate is required, it must be specifically requested. There is no charge if request accompanies the original order—$10.00 will be charged for certificate requests received after shipment of the item or items.

Warranty of Traceability

The reference standards of measurement of Electro Scientific Industries, Inc., are compared with the U.S. National Standards through frequent tests by the U.S. National Bureau of Standards. The ESI working standards and testing apparatus used are calibrated against the reference standards in a rigorously maintained program of measurement control.

The manufacture and final calibration of all ESI instruments are controlled by the use of ESI reference and working standards and testing apparatus in accordance with established procedures and with documented results.

(Reference MIL-C 45662)

Disclaimer of Implied Warranties

THE FOREGOING WARRANTIES OF ESI ARE IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED. ESI SPECIFICALLY DISCLAIMS ANY IMPLIED WARRANTIES OR MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. In no event will ESI be liable for special or consequential damages. Purchaser's sole and exclusive remedy in the event any item fails to comply with the foregoing express warranties of ESI shall be to return the item to ESI, shipping charges prepaid, and at the option of ESI obtain a replacement item or a refund of the purchase price.

Where an ESI product will interconnect with component not supplied by ESI. ESI does not warrant the ESI product against failures caused by mismatch of the non-ESI component to the ESI product, nor will ESI be liable for damages to the non-ESI component resulting from the mismatch.

Unless specifically requested by the customer, ESI does not inspect or test an instrument for compliance with applicable safety standards of the Bureau of Radiological Health or with any other governmental or industry standard. Customers who desire an inspection or test for conformity to a standard should specify the standard with particularity. Not all instruments can be modified to conform with standards adopted after the instrument was manufactured, and such modifications are not repairs, nor is failure to comply with a standard adopted after the date of manufacture a defect.

I510-381-30KDD

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